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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/693,244	10/24/2003	Takatoshi Tsujimura	CMO.0012US (92096US)	1416
21906	7590	01/09/2006	EXAMINER	
TROP PRUNER & HU, PC 8554 KATY FREEWAY SUITE 100 HOUSTON, TX 77024			TUROCY, DAVID P	
			ART UNIT	PAPER NUMBER
			1762	

DATE MAILED: 01/09/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/693,244

Applicant(s)

TSUJIMURA ET AL.

Examiner

David Turocy

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 21 October 2005.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-20, 22, 23 and 26-30 is/are pending in the application.
- 4a) Of the above claim(s) 19, 20, 22 and 23 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-18 and 26-30 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Response to Amendment***

1. The applicant's amendments, filed 10/21/2005, have been fully considered and reviewed by the examiner. The examiner notes the cancellation of claims 21 and 24-25 with the addition of new claims 26-30. Claims 1-20, 22-23, and 26-30 remain pending with claims 19-20 and 22-23 withdrawn due to a restriction requirement.

### ***Response to Arguments***

Applicant's arguments filed 10/21/05 have been fully considered but they are not persuasive.

The applicant has argued against the examiners use of the admitted state of the art as taught by the applicant's description, stating the cited pages discloses irradiating the  $\text{SiH}_4$  to break it down to the less reactive  $\text{SiH}_3$  before forming the film and not the claims  $\text{SiH}_2$ . The examiner respectfully disagrees with the assertion. Page 3 of the current disclosure clearly states applying a high energy electric field to a  $\text{SiH}_4$  source gas results in breaking the source gas into  $\text{SiH}_2$  and the prior art teaches a flow ratio and an electric field density, which satisfy the relationship as, taught by claim 13, and therefore the prior art must necessarily result in the formation of the polymer forming  $\text{SiH}_2$ .

The applicant has argued that there is no teaching in the process of Nakata that the  $\text{SiH}_4$  gas is converted to any other form of gas. While the examiner agrees Nakata fails to explicitly disclose the formation of an intermediate gas phase, the applicant and

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the prior art are both supplying  $\text{SiH}_4$  and  $\text{H}_2$  into a reaction chamber and applying a electric field, with similar electric field intensities, to the gases. Therefore, the prior art and the present claims, reflected by the claims, teach all the same process steps and thus the results obtained by applicants process must necessarily be the same as those obtained by the prior art. Therefore by applying an electric field in the chamber with  $\text{SiH}_4$  and  $\text{H}_2$ , with a flow rate ratio and electric intensity satisfying the claimed relationship, it must necessarily result in breaking the  $\text{SiH}_4$  to a third gas  $\text{SiH}_2$ , or activating the source gas to contain an element which forms a polymer due to bonding.

Either 1) the applicant and the prior art have different definitions of applying an high-intensity electric field, or 2) the applicant is using other process steps or parameters that are not shown in the claims to convert the  $\text{SiH}_4$  to  $\text{SiH}_2$ .

The applicant has argued against the Nakata reference stating the time for supplying the source gas is not obvious. However, it remains the examiners position that the process parameter of time is a known result effective variable. If time were low it would result in insufficient film thickness and too much time would result a larger film thickness then desired. Therefore it would have been obvious to one skill in the art at the time of the invention was made to determine the optimal value for the time for the source supplying process and the deposition process used in the process of Nakata in view of the admitted state of the art as taught by the applicants description, through routine experimentation, to impart the substrate with the desired film thickness.

All other arguments are directed to newly added claims or newly added limitations, which were not present at the time of the rejected claims. Therefore such limitations are considered on the merits below.

***Claim Rejections - 35 USC § 112***

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 1, 7, 8-14, 17-18, 26-28 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for supplying SiH<sub>4</sub> and H<sub>2</sub> for forming a microcrystalline film during a second process, does not reasonably provide enablement for forming a microcrystalline film during a second process using a first gas and a second gas. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims. While the specification clearly enables one of ordinary skill in the art that a first gas of SiH<sub>4</sub> and a second gas of H<sub>2</sub> using the process as claimed will result in depositing a microcrystalline film during the second process. The specification does not provide additional direction or working examples to one of ordinary skill in the art to provide any combination of various gases, each of which is within the scope of the claimed invention, to deposit a microcrystalline film during the second process without undue experimentation.

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4. In addition, claims 26 -28 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for supplying  $\text{SiH}_4$  and  $\text{H}_2$  at flow rate ratio, during the first process, to prevent a tin film from being amorphous, does not reasonably provide enablement for supplying a first gas and a second gas at a flow rate ratio so as to not deposit an amorphous film. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims. While the specification clearly enables one of ordinary skill in the art that a first gas flow rate of  $\text{SiH}_4$  and a second gas flow rate of  $\text{H}_2$  in a ratio to prevent an amorphous film. The specification does not provide additional direction or working examples to one of ordinary skill in the art to provide any combination of various gases at any of a multitude of flow rates, each of which is within the scope of the claimed invention, to supply a flow rate ratio to prevent an amorphous film deposition.

5. Claim 30 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter, which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The added limitation "depositing the microcrystalline thin film forms a majority of the microcrystalline thin film on the substrate" appears to be new matter. The examiner cannot ascertain support in the specification for such an added limitation. If the

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- applicant can provide support from the written description on the record then the new
- matter rejection will be withdrawn.

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter, which the applicant regards as his invention.

7. Claims 1-8 and 26-27 rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 includes the added limitation of depositing "the microcrystalline thin film during the second process" and also includes the limitation "performing the first and second process a plurality of times to form the microcrystalline thin film". It appears as though such limitations are contradictory to each other, where "the microcrystalline thin film" is deposited during the second process, but also requires multiple repetitions to deposit "the microcrystalline thin film".

### ***Claim Rejections - 35 USC § 103***

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of

the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

9. Claims 1-18, and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent 5686349 by Nakata, hereafter Nakata '349 in view of US Patent 6271062 by Nakata, hereafter Nakata '062.

Nakata '349 teaches a method of forming a microcrystalline thin film comprising a first process of supplying  $\text{SiH}_4$  and  $\text{H}_2$  comprising gases into a chamber with a substrate, a second process of supplying  $\text{H}_2$  alone to the chamber and repeating the first and second process a plurality of times without removing the substrate from the chamber (Abstract, Example 1). Nakata '349 discloses supplying  $\text{H}_2$  at a constant rate during both the first and second process and  $\text{SiH}_4$  has a first rate during the first process and is not supplied during the second process (Example 1).

While the examiner notes the process as taught by Nakata '349 does not teach of depositing a microcrystalline thin film in the second step, it is the examiners position that after stopping the flow of  $\text{SiH}_4$ , the process of Nakata '349 inherently results in at least a quantitative amount of continual deposition, during the second step, at which  $\text{H}_2$



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is maintained at a constant rate, due to the presence of  $\text{SiH}_4$  and  $\text{H}_2$  remaining in the process chamber. In addition, residual  $\text{SiH}_4$  remaining in the process chamber with the constant flow of  $\text{H}_2$  will result in a  $\text{H}_2$  to  $\text{SiH}_4$  dilution ratio to deposit a quantitative amount of microcrystalline thin film directly from the vapor phase, See Nakata '062 which discloses adjusting the hydrogen dilution ratio to deposit microcrystalline thin films directly from vapor phase (Column 5, lines 20-25). The examiner notes the claim as written only requires that a microcrystalline thin film is deposited during the second step and does not require no thin film deposition during the first step.

Nakata '349 fails to explicitly teach of converting the  $\text{SiH}_4$  to  $\text{SiH}_2$ , which contains a polymer-forming element, by the application of the electric field. However, as evidenced by the admitted state of the art discloses when applying a high-energy electric field to the  $\text{SiH}_4$  is broken down into a more reactive  $\text{SiH}_2$ , which may form a polymer by bonding to each other (Specification Page 3). In addition a flow ratio and an electric field density, which satisfy the relationship as, taught by claim 13, must necessarily result in the formation of the polymer forming  $\text{SiH}_2$ .

Nakata '349 teaches of supplying the gases with a flow rate ratio,  $r$ , equal to 100 and an electric field intensity,  $P$ , of  $1000 \text{ mW/Cm}^2$ , which satisfies the relationship as claimed (Example 1).

Therefore, the prior art and the present claims, reflected by claim 4 and 13, teach all the same process steps and thus the results obtained by applicants process must

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necessarily be the same as those obtained by the prior art. Therefore by applying an electric field in the chamber with  $\text{SiH}_4$  and  $\text{H}_2$ , with a flow rate ratio and electric intensity satisfying the claimed relationship, it must necessarily result in breaking the  $\text{SiH}_4$  to a third gas  $\text{SiH}_2$ , or activating the source gas to contain an element which forms a polymer due to bonding. Either 1) the applicant and the prior art have different definitions of applying an high-intensity electric field, or 2) the applicant is using other process steps or parameters that are not shown in the claims.

While the examiner notes the process as taught by Nakata '349 does not teach of depositing a third gas,  $\text{SiH}_2$ , to a surface of the substrate in the second step, it is the examiners position that after stopping the flow of  $\text{SiH}_4$ , the process of Nakata '349 inherently results in at least a quantitative amount of continual deposition of  $\text{SiH}_2$ , during the second step, at which  $\text{H}_2$  is maintained at a constant rate, due to the presence of  $\text{SiH}_4$  and  $\text{H}_2$  remaining in the process chamber.

Claim 8 and 10: The prior art and the present claims, reflected by claim 8, teach all the same process steps and thus the results obtained by applicants process must necessarily be the same as those obtained by the prior art. Therefore by supplying the second gas during a portion of the deposition of the third gas, it must necessarily result in reduction of formation of the polymer of the third gas prior to deposition. Either 1) the applicant and the prior art have different definitions of depositing the third gas during the

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- second process without the first process gas, or 2) the applicant is using other process steps or parameters that are not shown in the claims.

Claim 17: Nakata '349 teaches of a method of manufacturing a thin film transistor by forming a gate electrode, forming an insulation layer on the gat electrode and forming a channel layer film on the insulation layer by using the microcrystalline thin film forming method of claim 9 and then subsequently forming a source electrode on the channel layer (Column 3, lines 14-45).

Claim 14: Nakata '349 teaches all the limitations of this claim as applied to claim 9 above, however, they fail to disclose a supplying process of 2 seconds or less and the source deposition process longer then the source supplying process.

However, It is the examiners position that the process parameter of time is a known result effective variable. If time were low it would result in insufficient film thickness and too much time would result a larger film thickness then desired

Therefore it would have been obvious to one skill in the art at the time of the invention was made to determine the optimal value for the time for the source supplying process and the deposition process used in the process of Nakata '349 in view of the admitted state of the art as taught by the applicants description, through routine experimentation, to impart the substrate with the desired film thickness.

Claim 18: Nakata '349 teaches all the limitations of this claim as applied to claim 9 above, however, they fail to explicitly disclose the claimed distance for the microcrystalline film from the insulation layer. However, Nakata '349 discloses a portion of the channel layer comprises a microcrystalline thin film less then 500 angstroms from

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the insulation layer (Column 3, lines 14-45). In the case where the claimed ranges "overlap or lie" inside ranges disclosed by prior art a *prima facie* case of obviousness exists. *In re Wertheim*, 541 F.2d 257 191 USPQ 90. See MPEP 2144.05.

10. Claims 1, 26, and 29-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent 6919266 by Ahn et al, hereafter Ahn in view of US Patent 6833161 by Wang et al., hereafter Wang.

Wang, teaching a method of depositing a tungsten nitride film, discloses introducing a continuous carrier gas stream (second gas) and an ammonia (first gas) and then stopping the ammonia to supply the second gas and not the first gas to the chamber (Column 9, lines 15-45). In the second process, Wang discloses providing a third gas to effectively deposit the thin film and Wang discloses repeating the first and second process a plurality of time to form a film on the substrate (Column 9 lines 15-45). Wang fails to disclose the depositing of a microcrystalline thin film.

However, Ahn, teaching of depositing a tungsten nitride barrier layer by atomic layer deposition, discloses the deposited tungsten nitride film using atomic layer deposition is a microcrystalline structure (Column 5, lines 7-30). Ahn discloses the microcrystalline thin film has a flat surface due to smooth film growth (Column 5, lines 7-30).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Wang to effectively deposit a microcrystalline tungsten

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nitride as suggested by Ahn to provide a desirable barrier layer with a reasonable expectation of success to reap the benefits of a barrier layer with a smooth surface.

Claims 26 and 30: The process of Wang will result in the limitations of these claims.

### ***Conclusion***

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. US Patent 6329270 discloses PECVD deposition of microcrystalline thin film and discloses the crystalline structure of the deposited film is a result of the  $\text{SiH}_4$  to  $\text{H}_2$  ratio, i.e. the hydrogen dilution, and discloses high  $\text{H}_2$  amounts result in lower energy and lower deposition rates which results in depositing microcrystalline silicon (Column 6). US Patent 5242530 by Batey et al. discloses the film thickness per cycle is a function of the pulsing time of the  $\text{SiH}_4$ .

12. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the

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shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David Turocy whose telephone number is (571) 272-2940. The examiner can normally be reached on Monday-Friday 8:30-6:00, No 2nd Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

David Turocy  
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**TIMOTHY MEKS  
SUPERVISORY PATENT EXAMINER**